# THE DEADLY BATTLE OF INVENTION

## Machine Shops and Chemical Laboratories of World Pitted in Deadliest Duel

By CLEVELAND MOFFET



FOUR years of war inventions, discoveries, developments! What stupendous years!

Consider the record!

The airplane, an American invention that may win the war! And change civilization!

Cleveland Moffett

The submarine, another American invention!

The long distance gun!

Mustard gas—discovered by a young American chemist of English descent, although this fact is not generally known. I will speak of him presently.

There is an endless list of war inventions and war discoveries. In chemistry, in physics, in scientific farming, in surgery, in manufacturing, in almost every branch of human endeavor, there have been immense strides forward since the war began in 1914, so much so that posterity will probably regard this world conflict, for all its horrors and pain, as a blessing in disguise.

Nitrates out of the air, which means a revolution in agriculture and in the whole business of food supply—that is a direct consequence of the war!

A tunnel under the English Channel. Twenty minutes from island to mainland and no seasickness. That will be another consequence.

Rolling fortresses!

Radio-controlled torpedoes!

Transatlantic flight!

Mails carried through the air at ninety miles an hour! This is already an accomplished fact. In Spain, in England, in Italy, in America—everywhere, aerial letter-carriers are flying on regular schedules. Two hours and a half from Washington to New York! And that is only a suggestion of airplane possibilities.

### The Impossibilities And What Happens

How timid we are in grasping these possibilities! In grasping all possibilities of the future! We believe in what has been, we doubt what is to be. College professors prove that it is impossible to pitch a curve ball, impossible for a heavier-than-air air machine to fly, impossible for a locomotive to pull a train of cars, impossible for a gun to shoot a hundred miles, and then the thing happens and the college professors explain it!

Even practical men of affairs are slow to grasp the significance of new inventions. How many of them realized the importance of the motion picture eighteen years ago? It was a toy, an amusing trifle, they said. Now it rules the world!

Similarly, the airplane was declared for years to have no commercial future, to have reached the limit of its development. A thrilling contrivance for air stunts at country fairs—nothing else. Serious men, scientific, hard-headed engineers were saying that as late as 1914. You couldn't give away stock in an airplane enterprise.

Then came this war with its broadening of vision, its quickening of faith—that is, perhaps the greatest value of the war—and in the last four years men have learned more about airplane possibilities than they would have learned in forty years of peace—they have been compelled to learn.

To-day experts agree that successful ocean flight is merely a matter of intelligent preparation. No one doubts that the thing is possible, or that it will be accomplished in the near future. In all probability we shall see a transatlantic airplane service permanently established within the next year. The Handley-Page people speak confidently of flying their big machines by hundreds across to England—now!

Why not? Consider the speed that is already attained by standardized air machines! A hundred and fifty miles an hour! That means fifteen hours from America to Europe, or less with favorable winds!

Consider the engine power of airplanes that are in actual and successful operation—2,100 horsepower in a huge Italian flier, according to Captain Ugo d'Annunzio, this machine containing three Fiat engines of 700 horsepower each! And there are reports of a monster Italian airplane with engines developing 5,000 horsepower!

Consider that already some air machines have four engines, five engines, six engines; and some air machines weigh as much as fifteen tons and are able to carry two tons of useful load—bombs, freight, passengers—two tons of passengers meaning twenty-five persons!

And consider the speed records that have been already made! Three thousand miles from London to Constantinople in twenty-one hours, with several stops!

We can no more limit the size, power or speed of airplanes of the future than men in Robert Fulton's time could tell how steamships would develop as they watched the little Clermont paddle up the Hudson.

Let us now consider the submarine, another marvel of war development. The highly perfected German submarine!

Think what this monster of frightfulness already is!

A submerged ocean liner! A 3,000-ton vessel, freight carrier, ammunition carrier, death carrier; capable of cruising under all seas, of crossing all oceans, of remaining away from its base for many weeks. Capable of emerging suddenly at night a few miles off any coast city—say a few miles outside of New York Harbor—and of training its eight-inch guns, sub-calibred to carry twenty miles, upon defenceless hospitals, churches and homes.

That is the Prussian idea!

Then come bombs, hurtling through the darkness—fire bombs, explosive bombs, a score of them, a hundred of them, swiftly discharged by the lurking enemy who straightway sinks and is gone, leaving a burning city to mourn its dead and dying.

This is no perfervid imagination, but a perfectly possible happening, something that may be expected on Manhattan Island, so experts tell me, before the pleasant summer of 1918 is passed.

Nor is this all. War inventiveness has made it possible for these super-submarines to carry six or eight airplanes stowed away with folded parts, that may be quickly assembled on deck (an aeronautical engineer assures me that this work of assembling an airplane on the deck of a big submarine can be done by six men in a single hour) and then launched by night to circle over a sleeping city—New York for example—and drop fire bombs or explosive bombs upon such parts of it as seem most suitable for a Hun murder fest.

Horrible!

How, then can we think of this war invention as conducing to the betterment of mankind? Is there any good in it? Anything of usefulness or permanent value in it? Or is the submarine altogether evil, an accursed assassin of the deep?

No. It may even transpire that this engine of destruction has its large part to play in the Great Plan of human advancement and enlightenment that is obscurely unfolding in the midst of present world miseries.

### Anti-Submarine Inventions

Peace will undoubtedly find some serviceableness for these marvellous underwater boats—it is inconceivable that so much labor and ingenuity shall go to waste. Already the submarine has done much for men in forcing them to defend their ships. It has developed one war invention that will be useful for years to come—that may, in fact, save more lives than German submarines have destroyed.

I can give some interesting details concerning this invention, since I have been privileged to witness, in part, its operation. It is a listening or sound amplifying device, by means of which the presence of an unseen submarine is revealed automatically to a pursuing destroyer or patrol vessel with considerable exactness, both as to direction and distance, these being electrically recorded on indicating dials.

The result is that an officer, reading these dials by night, in a fog, at any time, knows that a submarine (he recognizes her engine sounds and propeller sounds) is so many thousand yards away at *exactly* such a point or fraction of a point of the compass. And he steers accordingly, moving nearer and nearer to his quarry until a depth bomb settles things.

It is no violation of confidence to explain that these sounds from distant submarines are received by "listening ears"—that is, steel diaphragms, a foot or more in diameter, set deep down in the hulls of battleships or destroyers far below the water level, set in circular openings cut through the outer plates, so that they are in direct contact with the water.

Not only are all up-to-date battleships and destroyers provided with these "listening ears," but submarines themselves are similarly equipped, both for offensive and defensive purposes. All of which has a much more important bearing upon the struggle now going on between ships and submarines than is generally realized.

### A New Water Wireless System

I may add that, by means of a sound-creating device (an electric oscillator used in connection with the "listening ears") it is possible to send forth sounds, through water vibrations, as well as to receive them. This practically creates a water wireless system, or a water telephone system.

Early in the war I asked the inventor of this system, Professor R. A. Fessenden, if it would be possible to transmit these vibrations through the water to a considerable distance.

"To a very considerable distance," he said. "We have already received them at a distance of thirty-two miles, but that is only a beginning—like the first wireless message sent across the English Channel, which seemed wonderful fifteen years ago, but is nothing to-day."

"Do you think it will be possible to transmit these water vibrations over, say, one hundred miles?"

"I have no doubt of it; perhaps several hundred miles, with larger oscillators and more powerful currents."

"And you can send messages in this way through the water itself, with no wires or cables?"

"Exactly. It is simply a matter of making the oscillator toot out dots and dashes according to the code. Now you see the importance of these oscillators in naval warfare, for a battleship equipped with such instruments can talk to its own submarines while they are miles away and submerged and can actually direct their movements against an enemy's vessels."

He then described a government test of his invention made outside of Newport harbor, in which the United States submarines K-1 and K-2 exchanged water-wireless communications without a mistake at the rate of ten words a minute when they were eight miles apart.

"We not only succeeded in receiving water-wireless messages between submarines," said Professor Fessenden, "but at short distances, up to half a mile, we were able to talk with the human voice from one submarine to the other. I would say to the transmitter, for instance: 'Please ask Captain So and So to come to the 'phone,' and a moment later by water-wireless I would hear the captain's voice asking what I wanted."

### Doing Away With Collisions

The usefulness of this water-wireless invention in times of peace lies in the fact that it will practically do away with the danger of collisions between ships at sea, since it informs one vessel of another vessel's approach while they are miles apart, even in storm or darkness; it also lessens the chances of another Titanic disaster by recording the echo of a ship's foghorn thrown back from an iceberg drifting in a fog.

I may point out, in conclusion, that the greatest service of the submarine, strange as this may seem, may come in compelling men to accept the idea of universal and permanent peace.

The submarine may prove to be the *reductio ad absurdum* of all future wars!

How so?

Because if there are to be future wars, then all nations must prepare for them, and the cost of such preparation, taking account of inevitable submarine depredations, is too staggering for the world to face it any longer.

If wars are to continue, if submarine attacks upon commerce are to continue, then presently we shall see all the men, women and children upon earth toiling miserably for no other purpose than to carry the burden of past war indebtedness, while preparing for new conflicts, new horrors, new burdens of debt.

Which is absurd!

The very efficiency of the submarine makes us realize how absurd this is. Half the world striving frantically to create wealth faster than the other half can destroy it! Half the world striving frantically to sink ships faster than the other half can build them, although the salvation of all depends upon those ships!

No! That is not good enough.

Man was made in God's image for something better than that; he was made for happiness, for useful service. And the escape from this dilemma lies in escape from the bondage of war, in escape from the curse of militarism. As to the problem of submarine attack upon defenceless vessels, the obvious solution is to banish from the seas all submarines equipped for warlike purposes.

### Poison Gas in Modern Warfare

Let us now consider poison gas, that most fiendish method of destruction that has entirely changed the course of modern warfare.

"It is within the realm of possibilities," declared a great English poison gas authority recently, "that this war will be finished, literally, in the chemical laboratory."

There is no question that victory in the present world conflict will come to whichever side is able first to—

(a) Discover a gas that is colorless, odorless, invisible and highly poisonous.

(b) Deliver this gas against the enemy under surprise conditions and in practically limitless quantities.

When poison gas was first used (April, 1915) at Ypres against the defenceless British the results were so ghastly that even the Germans were shocked. Six thousand dead bodies—poisoned suddenly! Ten thousand splendid young men writhing on the ground in hideous torture! There had never been anything like it in the history of the world. And that was only the beginning!

Perhaps the most infernal variety of poison gas that has since been developed is dichloro-diethylsulphide, or mustard gas, so called because of a faint smell like garlic.

I recently met the discoverer of this gas in one of our war munitions factories, and he told me how he came upon this stuff years ago when he was studying in Germany under a famous German scientist. I suppose that this German claims to have discovered mustard gas himself.

"Would you like to see some of it? Would you like to take a whiff of it?" he smiled. "Here you are. Don't be afraid."

He produced a glass bottle containing about a pint of reddish-brown liquid and fingered the stopper.

"This is what does the business, if you have enough of it. It nearly killed me. The fumes of it go right through your clothes and make horrible burns. I lay for months in a hospital. There! Try it!"

He drew the stopper and held the bottle under his nose, then gave it to me. I felt as I did once in the West Indies when a leper offered me his hand. But I took the open bottle and held it under my nose, as the chemist had done. What childlike faith we have!

### Nine Hours Later It Kills

There was scarcely any odor. No sign of fumes arising. No sensation of any kind, or indication that anything was happening.

"That's the worst of it," laughed the scientist. "Mustard gas fools you. You think there is nothing there, then suddenly nine hours later it kills you, or if it does not quite kill you you wish it had."

"Nine hours later?" I wondered why he was so casual with that stopper, but he reassured me, explaining that the deadliness of the gas came with a much greater concentration. I need not worry.

Greater concentration of poison gas! That is what is necessary for big results. Immensely greater quantities of poison gas!

Another distinguished American chemist assured me the other day that poison gas enters much more largely into Germany's great campaign on the Western front than is generally realized.

"Germany's successes since March, 1918," he said, "have been largely due to poison gas. And the long pauses between her massed attacks may be accounted for by the fact that once her supply of poison gas is used up Germany must wait until she can make a new supply before she strikes again. And please note that Germany makes poison gas very slowly. I need not go into the reasons for this, but we happen to know that in the case of mustard gas it takes Germany five times as long to make a given quantity of this deadly stuff as it would take America to make it.

### Wearing Gas Mask For Four Hours

"Furthermore," he continued, "all experts agree that the gas masks furnished to our American soldiers are much superior to German masks—that is, they give protection for a greater number of hours and cause less inconvenience."

"For how long a time can these masks be kept on in the event of a prolonged gas attack?" I asked.

"For several hours—four or five hours."

"You mean the mask would cease to protect after that time?"

"No, I mean that the limit of human endurance would be reached after that."

This chemist is a mild mannered man, with kindly blue eyes and a pleasant voice, but he proceeded to paint for me an incredibly horrible picture of possible destruction by poison gas that can be accomplished by America.

"Yes," he went on, "America has it in her power to win this war quickly, to put Germany entirely out of business, if she will spend millions or billions enough in making poison gas chemicals and transporting them to Europe. I would sooner waste American chemicals than waste American blood. Wouldn't you?"

He then explained to me his plan, which is simply to use the entire power of Niagara Falls, transformed into electrical energy, in making poison gas.

"We are already using for war purposes the little finger of this Niagara giant. Why not use all the giant's boundless strength? Would Germany leave Niagara Falls practically idle, as we do, for the pleasure of tourists, if she had the handling of it? No. Germany would harness every drop of water in the American Falls, every drop of water in the Canadian Falls, with their combined power of so many hundreds of millions of horses, to the greatest electro-chemical gas producing plant ever dreamed of. Germany would keep that plant working night and day, and we Americans would do the same if we realized our opportunity, night and day, until we were able to drench the whole German battle line, their whole cursed battle area, say a region two hundred miles long and ten miles deep, with poison gas and keep it drenched, that is, keep gas shells falling from our guns, gas bombs falling from our airplanes ceaselessly for twenty-four hours if necessary. But it would not be necessary. Ten hours would do; after that the Germans would be dead."

"Dead—whole armies?"

"Yes. All who did not flee from that poisoned area would be dead, and comparatively few would be able to flee. The war would be over in ten hours. Niagara Falls and American chemists would have won the war."

"You really think such a thing is possible?"

### If Niagara Were Mobilized

"I do. It is merely a matter of organization, merely a matter of paying the price—in chemicals."

"And Germany would make no answering move? She would have no way of defending herself?"

"I don't think so. I don't see any defence. We have Niagara Falls in our possession and Germany hasn't. It is up to us to use Niagara Falls."

There are three arguments against the plan of meeting German frightfulness with still greater American frightfulness.

One argument is that it is abominable to even think of such wholesale destruction. It is a wicked plan. But all war is wicked, and Germany's present advantage is largely due to the fact that she has thought of various kinds of wickedness first and has forced the Allies to follow her wicked example (as in the original use of poison gas) after precious months have been wasted. Why should not the Allies take the lead for a change?

The second argument is that it would require many months to carry out this Niagara gas plan. But it requires many months to carry out every feature of our war programme, to make ships, guns, airplanes, etc. Besides, every one knows that we are already preparing to make immense quantities of poison gas, so that next year we may show no inferiority to Germany in this respect. Why not prepare for an overwhelming superiority here? Why not put Niagara Falls on the gas job now, if this would give us a chance to win the war quickly, as experts believe it would—say, in the summer of 1919, rather than in the summer of 1922?

The third argument against the Niagara plan is that if we showered poison gas in such vast quantities over the German armies they would retaliate by bombarding Paris and London with poison gas from airplanes. But if the war was over, if the German armies were put permanently out of business, there would be no danger of retaliation; *they would have nothing to retaliate with!*

There is no impropriety in speaking of this plan, since Niagara Falls belongs to us, not to Germany. It is a world monopoly at the disposition of the Allies, if they wish to use it.

### Long Distance Gun A Great Sensation

In conclusion, I must speak of the long distance gun, a startling novelty of the war, although scientists now profess to have known all about this possibility long before it was realized by the Germans. And they tell us that this seventy-five-mile engine of destruction has no real formidableness owing to its short life from barrel erosion (thirty or forty shots at the most,) its difficulty of manipulation and the relatively small projectile that it throws.

"This gun is but a magnificent instrument of bluff," declares a French authority. "Its military value is zero, and its life appears to be limited to a mere score or two of shots.

We must admit, however, that the Germans scored a distinct *succès de sensation* with this extraordinary war invention. And they have done substantial damage to Paris, not only in casualties and material destruction, but by causing the frightened exodus of hundreds of thousands from the French capital. It is a pity that some scientists of the Allies who claim to have had this knowledge did not use it first against Metz or Cologne.

The long distance shot is fired at a very high inclination, 43½ degrees, so that the projectiles that reached Paris must have risen to the extraordinary height of twenty-four miles at the topmost point of their flight, where the air is so rarefied that it offers little resistance.

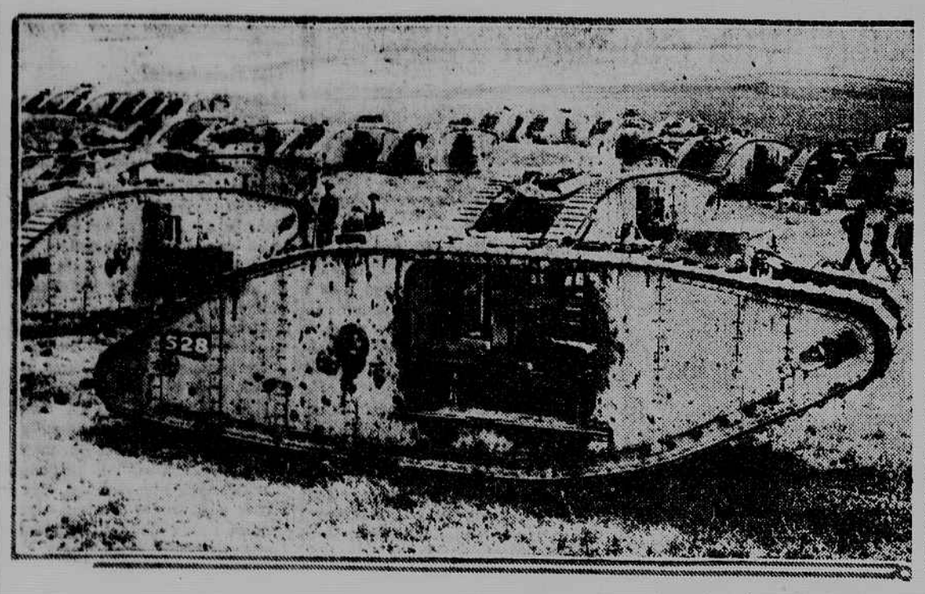
Twenty-four miles above the earth!

Since this planet was created—flung off from the sun millions of years ago—no fragment of it, no creature on it, nothing ever connected with it, ever rose so far above its surface!

This expert also assures me that one of our biggest coast defence guns (16 inches), sub-calibred as indicated, could be made to throw projectiles for 100 miles. In other words, such a gun could drop shells in New York City from New Haven, Philadelphia, Poughkeepsie or Easton, Penn.

*Which is some shooting!*

## LAND MONSTERS OF THE GREAT WAR



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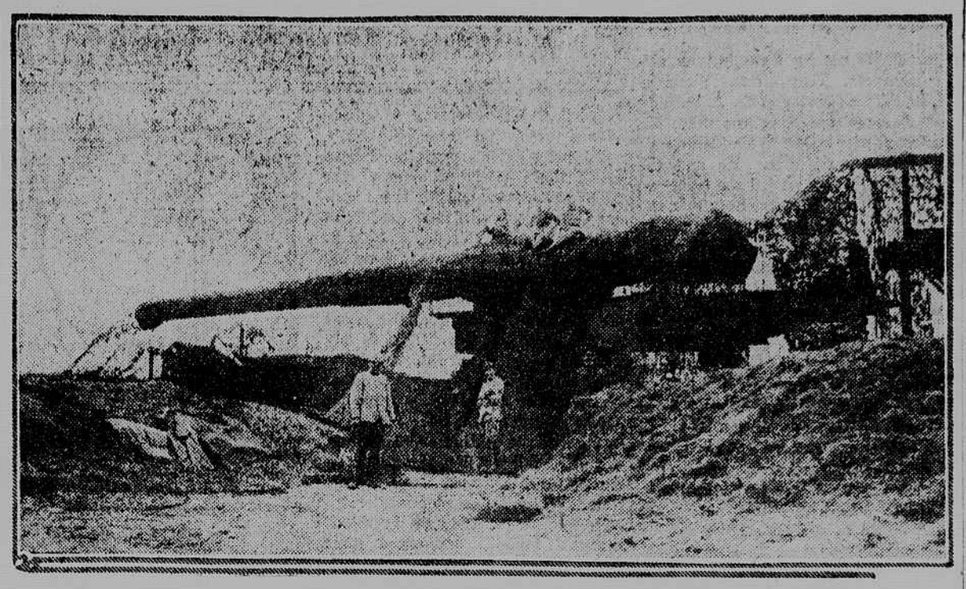
A field of British tanks gathered behind the lines.



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A great French gun, camouflaged against air observation.

## PROTECTION AGAINST GAS

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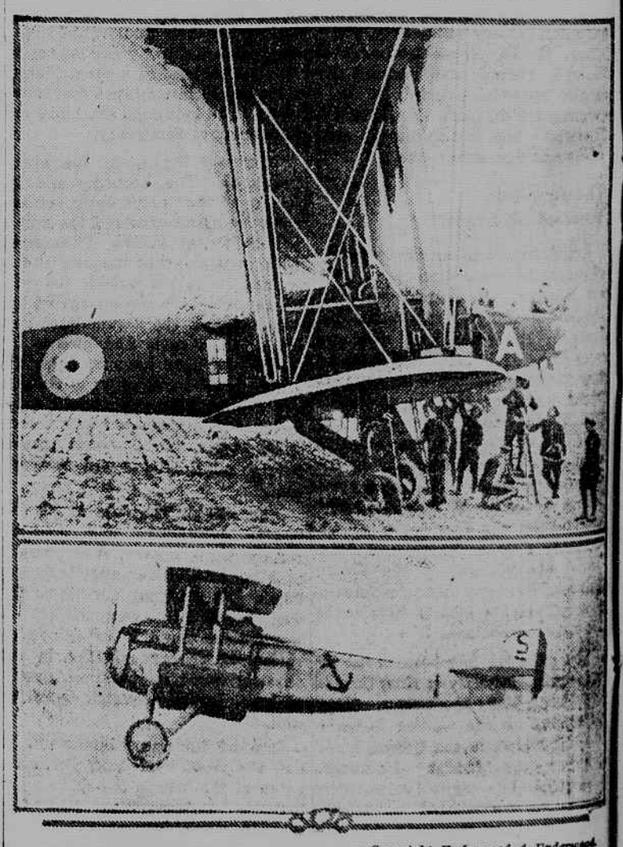
Both man and beast along the Western front now have to spend a great part of their lives in gas masks.

## THE EXTREMES OF AIR FIGHTERS



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Above—A giant Handley-Page bombing 'plane. Below—A tiny Spad scout 'plane, which could be carried on top of the Handley-Page